Capillaries: Structure, Function, and Significance

By Lynne Eldridge, MD Updated on October 19, 2025

Key Takeaways

- Capillaries deliver oxygen and nutrients to cells and remove carbon dioxide and waste.
- There are three types of capillaries: continuous, fenestrated, and sinusoidal, each with specific functions.
- Capillary malfunction can lead to conditions like petechiae and macular degeneration.

Capillaries are the smallest blood vessels in the body, connecting the smallest arteries to the smallest veins. They deliver oxygen and nutrients to cells while removing carbon dioxide to be eliminated from the lungs.

There are different types of capillaries with specific functions in the body. When these vessels malfunction become injured, or are diseased, they can break or deprive cells of the oxygen they need to survive. This can lead to conditions ranging from petechiae ("blood spots") to macular degeneration (a degenerative eye disease).1

This article describes the structure and function of capillaries. It also explains the effects of capillary dysfunction and the diseases and conditions that cause them.

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Capillary Structure

Capillaries form the connection between the body's smallest arteries (called arterioles) and the body's smallest veins (called venules). There are about 40 billion capillaries in the average human body.1

Capillaries are extremely thin, measuring approximately 5 micrometers in

diameter. They are so small that red blood cells need to flow through them single file.1

The walls of capillaries are composed of only two layers of cells surrounded by a layer of protein called the basement membrane.2

Where Capillaries Are Found

Capillaries are found throughout the body, although the distribution of them in tissues can vary widely.

The lungs are rich with capillaries that exchange oxygen and carbon dioxide via tiny air sacs in the lungs called alveoli.1 Outside of the lungs, capillaries are most abundant in metabolically active tissues (meaning those like the liver, brain, heart, and kidneys that convert nutrients to energy at a faster rate).3

Capillaries in the central nervous system are also involved in the blood-brain barrier. This barrier limits the ability of toxins (including certain medications) to pass through into the brain. Drugs that act on the brain need to be designed to circumvent this barrier.4

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Types of Capillaries

There are three types of capillaries in the body that have specific functions:2

- **Continuous capillaries** are enclosed and have no perforations in them. They are present in muscle, skin, fat, and nerve tissue.
- **Fenestrated capillaries** have small pores that allow small molecules (like water) to be passed back and forth between tissues. They are located in the intestines, kidneys, and endocrine (hormone-producing) glands.
- **Sinusoidal capillaries** have large open pores that blood cells can pass

through so they can be filtered and have defective cells removed. They are present in the liver, lymph nodes, and spleen.

Capillary Function

Capillaries are responsible for exchanging gases, fluids, and nutrients in the body. While arteries deliver these to the capillaries, the capillaries are where the actual exchange takes place in cells.5

The capillaries also receive carbon dioxide (and waste from cells so that they can be delivered by veins to the lungs (for removal by exhalation) and the kidneys and liver (for removal in urine and stool).5

Role in Blood Pressure and Circulation

Capillary beds help maintain a constant flow of blood through a process called autoregulation. The process is maintained by muscular fibers called precapillary sphincters that automatically contract (narrow) when blood flow needs to be increased and dilate (widen) when blood flow needs to be slowed.2

When you exercise, more capillary beds are recruited to prepare for an increased need for oxygen in tissues. The same mechanisms are involved in the regulation of blood pressure.2

Capillary Microcirculation

Capillaries regulate fluid movement between the circulatory system and tissues. This process is determined by the balance of two forces: hydrostatic pressure and osmotic pressure.5

Hydrostatic pressure pushes fluids and nutrients out of capillary walls through pores in fenestrated capillaries. The pressure is caused by the force of blood entering the capillary.

Osmotic pressure occurs as the blood returns to the heart, causing excess fluids and wastes to be drawn back into fenestrated capillaries for elimination from the body. Osmosis is caused by the imbalance of salt and water on the inside and outside of capillaries.

Physiological Effects of Capillaries (and What They Mean)

Capillaries are involved in many physiological effects in the human body, some of which indicate a medical concern.

Examples include:

- **Skin blanching**: Pressure on the skin presses blood out of the capillaries and causes blanching, or the lightening of the skin, when the pressure is removed. Prolonged blanching can occur with frostbite or Reynaud's syndrome.6
- **Petechiae**: This skin condition occurs when capillaries break, causing blood to leak into the skin and create red spots that persist with pressure. These can occur with certain infections, leukemia, and thrombocytopenia (low platelets).7
- **Capillary refill**: This is the speed at which capillaries refill with blood after pressure is removed. This can be seen when you press a fingernail into the skin and see how fast it recovers. A slow refill may be a sign of dehydration or hypothermia.2
- **Telangiectasia**: Also known as spider veins, these occur when capillaries widen and/or become gnarled. Family genetics can increase your vulnerability to them, but obesity, heavy alcohol use, excessive sunlight, and hormonal changes can also cause them.8
- **Third spacing**: When excess fluids are forced out of capillaries, they can cause fluid overload in surrounding tissues. This phenomenon, called third spacing, occurs when the immune system causes inflammation or an allergic reaction causes a rash or hives.2
- **Rosacea**: This is a long-term inflammatory skin condition that causes capillaries to enlarge, giving the skin a permanent pink or reddish flush. The cause of this harmless condition is unknown, but hot weather, alcohol, caffeine, sunlight, or stress can make it worse.9

Associated Conditions

Capillaries are involved in several health concerns. Some are relatively common while others are rare.

Certain Birthmarks

A small percentage of children are born with a red or purplish birth caused by dilated capillaries. Also known as strawberry hemangiomas or "port-wine stains," these are a cosmetic issue rather than a medical concern, although they can bleed when irritated.10

Capillary Malformation

Capillary malformation may occur as part of an inherited syndrome present in roughly one in 100,000 people of European ancestry. In this syndrome, there is more blood flow than normal through the capillaries near the skin, which results in pink and red dots on the skin.

These may occur alone, or people may have other complications of this syndrome such as arteriovenous malformations (abnormal connections between arteries and veins) which, when in the brain, can cause headaches and seizures.11

Systemic Capillary Leak Syndrome

A rare disorder known as capillary leak syndrome involves leaky capillaries, which may result in constant nasal congestion and episodes of fainting due to rapid drops in blood pressure.

This syndrome also may occur due to adverse drug reactions during cancer treatment and can lead to severe and potentially life-threatening complications.12

It's also been noted in people diagnosed with COVID-19 infections, as well as some people who received COVID-19 vaccinations.13

Macular Degeneration

Macular degeneration, now the leading cause of blindness in the United States, occurs secondary to damage in the capillaries of the retina (the nerve-filled tissue at the back of the eye).14

Macular degeneration is an aging-related disease that blurs central vision caused by damage to the macula (the part of the eye that controls straight-ahead vision).

14 Sources

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Additional Reading

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